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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/091,108	03/05/2002	Scott Lee Wellington	TH-1759X (US)	5886

23632 7590 01/19/2007

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EXAMINER	
LEUNG, JENNIFER A	
ART UNIT	**PAPER NUMBER**
1764	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/19/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

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Office Action Summary	Application No.	Applicant(s)	
	10/091,108	WELLINGTON ET AL.	
	Examiner	Art Unit	
	Jennifer A. Leung	1764	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08 November 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-8,10-28,32-35 and 40-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-8,10-28,32-35 and 40-45* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's amendment filed on November 8, 2006 has been received and carefully considered. Claims 3, 9, 29-31, 36-39 and 46 are cancelled. Claims 1, 2, 4-8, 10-28, 32-35 and 40-45 are under consideration.

Information Disclosure Statement

2. The information disclosure statement (IDS) filed on October 16, 2002 fails to comply with 37 CFR 1.98(a)(2) because a copy of the cited "Search Report dated 10/09/02" has not been provided. The IDS has been placed in the application file, but the cited search report has not been considered.

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claims 1, 2, 4-8, 10-15, 17, 19-21, 25, 32-35, 40-43 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al. (US 5,229,102) in view of Mikus et al. (WO 99/18392) and Topsoe (US 5,169,717).

Regarding claims 1, Minet et al. (FIG. 1; column 3, line 55 to column 5, line 6) discloses an apparatus comprising:

a) a steam reforming reactor **10** comprising two concentric sections including a larger outside section (i.e., containing burners **14**) and a smaller inside section (i.e., interior **11a**, defined by membrane tube **11**) and an annulus containing reforming catalyst between said sections (i.e., annulus **16** containing reforming catalyst **17**);

said annulus section **16** having an inlet for steam and vaporizable hydrocarbon (i.e., via connection **15**), a flow path for hydrogen and by-product gases in said annulus section **16**, and an outlet for said by-product gases (i.e., via point **D**);

said outside section being in heat transferring contact with said annulus section **16** (i.e., via heat transfer through metallic tube **13**), and having a heating means comprising inlets for fuel gas and combustion air in communication with a plurality of vertically spaced burners **14** for distributing radiant heat to said annulus section **16** via the tube **13**; and

said inside section **11a** having a hydrogen-selective, hydrogen-permeable membrane (i.e., located on catalytic ceramic membrane tube **11**) positioned either on the inside or outside of said inside section **11a**, and an outlet for hydrogen (i.e., via pipe connection **12a**) which permeates through said membrane **11** from said annulus section **16** into said inside section **11a** and passes through said outlet **12a**.

Minet et al. is silent as to whether the heating means may instead comprise an inlet for preheated air or other oxidant and a plurality of tubes for fuel gas, said tubes having openings through which the fuel gas flows and is mixed with said air or other oxidant resulting in flameless distributed combustion. In contrast, the combustion disclosed by Minet et al. is not flameless, as evidenced by the flames generated by burners **14**.

Mikus et al. (FIG. 1, 3; page 8, line 3 to page 10, line 15; page 10, line 25 to page 11, line 3) teaches a heating means comprising an inlet for preheated air or other oxidant (i.e., inlet **2**) and a plurality of tubes for fuel gas (i.e., fuel conduit **5**, shown in plurality in FIG. 3), said tubes having openings through which the fuel gas flows (i.e., fuel nozzles **6**) and is mixed with said air or other oxidant (i.e., within the oxidation reaction chamber **1**) resulting in "flameless distributed

combustion," (specifically, page 8, lines 10-17) whereby uniform tailored, controlled heat is transferred to an adjacent process chamber **8**. The process chamber **8** may comprise a catalytic steam reformer (page 13, lines 17-25; page 16, line 34 to page 17, line 30). It would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute the heating means of Mikus et al. for the heating means in the apparatus of Minet et al., on the basis of suitability for the intended use, because the "flameless distributed combustion" provides a controllable heat flux into a process chamber, from a heat source which has a uniform temperature, and a very low creation of NOx, as taught by Mikus et al. (page 5, lines 1-7).

In view of the newly added limitation, Minet et al. discloses that the steam reforming reactor **10** may be used for generating hydrogen for applications requiring higher pressures, such as the production of ammonia (column 4, lines 52-57). Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to incorporate the steam reforming reactor **10** in a plant for the production of ammonia, as specifically suggested by Minet et al. Minet et al., however, is silent as to the apparatus comprising b) a fuel cell in communication with the outlet **12a** for hydrogen of said steam reforming reactor **10**.

Topsoe (FIG. 3, 4; column 6, line 32 to column 7, line 39) teaches an apparatus comprising a steam reforming reactor (i.e., for primary reforming, or secondary reforming) located in the "front end" portion **24** of a plant for the production of ammonia. In addition, the apparatus comprises a fuel cell **29** in communication with the hydrogen outlet of the steam reforming reactor. It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a fuel cell to the modified apparatus of Minet et al., on the basis of suitability for the intended use thereof, because incorporating a fuel cell into the ammonia

process improves the overall energy balance of the process by offering a possibility for using a purge gas containing hydrogen as well as an off-gas of carbon dioxide to generate electricity, as taught by Topsoe (column 1, lines 17-55).

Regarding claims 2 and 43, Minet et al. further discloses an inlet adapted to convey a sweep gas comprising steam (i.e., H_2O steam supplied to the interior **11a** of the membrane tube **11** via connection **12** at point **B**; FIG. 1; column 4, lines 17-25).

Regarding claims 4 and 5, Minet et al. discloses the reforming catalyst **17** comprises at least one Group VIII transition metal; in particular, nickel metal (column 3, lines 67-68).

Regarding claims 6-8, 10 and 11, Minet et al. further discloses that typical reforming catalysts comprise nickel deposited on a support comprising oxides of Group IIIA; in particular, alumina support materials (column 1, lines 19-41). It would have been obvious for one of ordinary skill in the art at the time the invention was made to select the typical reforming catalyst for the reforming catalyst **17** in the apparatus of Minet et al., because the use of such catalysts is well known in the art of steam reforming, as evidenced by Minet et al.

Regarding claim 12, Minet et al. discloses the hydrogen-permeable selective membrane (i.e., on catalytic ceramic membrane tube **11**; FIG. 1) comprises one or more Group VIII transition metals or alloys; in particular, nickel (column 4, lines 3-25; column 6, lines 9-17).

Regarding claims 13-15 and 17, Minet et al. discloses the hydrogen permeable membrane (i.e., on catalytic ceramic membrane tube **11**; FIG. 1; column 4, lines 3-25) being situated on a porous ceramic support comprising oxides of Group IIA; in particular, alumina (i.e., the nickel or other suitable catalytic material as well as Layer 1, Layer 2 and Layer 3 being situated on a support of alpha alumina; see TABLE 2).

Regarding claims 19-21, Minet et al. discloses said membrane support (i.e., a Support of alpha alumina; see Table 2; column 4, lines 3-25) provides an intermediate layer (i.e., Layer 1, or Layer 2, or Layer 3; see Table 2) between the membrane and the catalyst **17**. The support of alumina inherently limits heat transfer to the membrane, as defined by applicant in section [0048] of the specification.

Regarding claim 25, Minet et al. discloses the membrane has a thickness in the range of 10 Angstroms to 150 μm (i.e., see Table 2, column 4, lines 3-25, wherein the sum of Layer 1, Layer 2, and Layer 3 is about 85 microns in thickness).

Regarding claims 32 and 33, Topsoe teaches that a suitable fuel cell comprises a high pressure molten carbonate fuel cell (i.e., a Molten Carbon Fuel Cell, MCFC, operating at pressures up to 120 psia, or an Integral Reforming Molten Carbonate Cell, IRMCFC, operating at pressures up to 120 psia; see Table 1; column 1, line 57 to column 2, line 66).

Regarding claim 34, Minet et al. is silent as to the steam reformer **10** being "scalable and easily adjustable to any size fuel cell." In any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the steam reformer to be scalable and easily adjustable to any size fuel cell in the modified apparatus of Minet et al., on the basis of suitability for the intended use, because it has been held that changes in size involve only ordinary skill in the art. *In re Rose*, 220 F.2d 459, 463, 105 USPQ 237, 240 (CCPA 1955).

Regarding claim 35, Minet et al. is silent as to the steam reformer **10** being mobile. In any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to configure the steam reformer to be mobile in the modified apparatus of Minet et al., on the basis of suitability for the intended use, because making an apparatus portable was held to

have been obvious, *In re Lindberg* 93 USPQ 23 (CCPA 1952).

Regarding claims 40-42, Minet et al. further discloses the steam reformer tube **13** being constructed from high alloy material, such as SS304, SS310, SS316, or the like (column 3, line 68 to column 4, line 2). For instance, the material SS304, a.k.a. AISI 304 stainless steel, comprises about 18% Cr and about 8% Ni, with the balance comprising iron.

Regarding claim 45, as best understood, the modified apparatus of Minet et al. structurally meets the claim because the modified apparatus includes all of the claimed structural elements. The recitation that an element is "adapted to" perform a function is not a positive limitation but only requires the ability to so perform. It does not constitute a limitation in any patentable sense. *In re Hutchison*, 69 USPQ 138.

4. Claims 16, 18, 22 and 25-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al. (US 5,229,102) in view of Mikus et al. (WO 99/18392) and Topsoe (US 5,169,717), as applied to claims 1, 12 and 13, and further in view of Lin et al. (EP 1 024 111).

Regarding claim 16, 18 and 22, Minet et al. is silent as to the whether the hydrogen-permeable membrane **11** may instead comprise a support of porous metal, and/or a membrane selected from palladium and palladium alloys. Lin et al. (FIG. 1) teaches a hydrogen-permeable membrane (i.e., on hydrogen-permeable membrane tube **14**) located within a steam reforming section containing reforming catalyst **13**, wherein the hydrogen-permeable membrane includes a porous substrate selected from porous stainless steel or porous ceramic material, and a membrane comprising a thin metal layer of palladium or a palladium alloy (see section [0012]). It would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute the hydrogen-permeable membrane of Lin et al. for the hydrogen-permeable

membrane **11** in the modified apparatus of Minet et al., on the basis of suitability for the intended use thereof, because the hydrogen-permeable membrane of Lin et al. provides a high hydrogen permeation flux that allows both the reforming temperature and the transmembrane pressure different to be reduced to a lower level. The reduced temperature and transmembrane pressure difference can provide the benefits of using less expensive material for the entire reactor, saving heat energy, and reducing undesirable effects on the mechanical strength and stability of the hydrogen-permeable membrane, as taught by Lin et al. (see section [0015]). In any event, the substitution of known equivalent structures involves only ordinary skill in the art. *In re Fout* 213 USPQ 532 (CCPA 1982); *In re Susi* 169 USPQ 423 (CCPA 1971); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *In re Ruff* 118 USPQ 343 (CCPA 1958).

Regarding claims 25-27, Lin et al. further teaches that the hydrogen-permeable membrane (i.e., the thin metal layer) has a thickness of 1 to 20 μm (section [0012]), which lies within the claimed range.

Regarding claim 28, Lin et al. further teaches that the hydrogen-permeable membrane has a measured permeability of hydrogen in the range of 3-10 m^3/m^2-h-$atm^{0.5}$ (section [0019]), which lies within the claimed range.

5. Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al. (US 5,229,102) in view of Mikus et al. (WO 99/18392), Topsoe (US 5,169,717) and Lin et al. (EP 1 024 111), as applied to claims 1, 12 and 22 above, and further in view of Juda et al. (US 5,904,754) or Rosset (US 2,958,391) or Behr et al. (US 4,496,373).

The combined teachings of Minet et al., Mikus et al., Topsoe and Lin et al. are silent as to the hydrogen-permeable membrane comprising at least one of the instantly claimed Pd alloys. In

any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute at least one of the instantly claimed alloys for the hydrogen-permeable membrane in the modified apparatus of Minet et al., on the basis of suitability for the intended use thereof, because the substitution of known equivalent structures for providing the same function of hydrogen permeation would involve only ordinary skill in the art. *In re Fout* 213 USPQ 532 (CCPA 1982); *In re Susi* 169 USPQ 423 (CCPA 1971); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *In re Ruff* 118 USPQ 343 (CCPA 1958). Juda et al. (column 3, line 1 to column 4, line 49) teaches a known hydrogen-permeable membrane comprising an alloy of Pd with 40% copper for use as a wall connecting high and low pressure chambers of a hydrogen generator. Rosset (column 2, lines 16-44) teaches another known hydrogen-permeable membrane comprising an alloy of Pd with small amounts up to about 60% silver, or preferably from about 25 to about 40 atom percent silver. Behr et al. (column 1, line 42 to column 2, line 8) teaches yet another known hydrogen-permeable membrane comprising an alloy of Pd with at least 7 % Y, or at least 45 % Cu.

6. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al. (US 5,229,102) in view of Mikus et al. (WO 99/18392) and Topsoe (US 5,169,717), as applied to claims 1 and 12 above, and further in view of Rosset (US 2,958,391).

The combined teachings of Minet et al., Mikus et al. and Topsoe are silent as to the hydrogen-permeable membrane being selected from platinum or platinum alloys. In any event, it would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute a membrane selected from platinum or platinum alloys for the hydrogen-permeable membrane in the modified apparatus of Minet et al., on the basis of suitability for the intended

use thereof, because the substitution of known equivalent structures for providing the same function of hydrogen permeation would involve only ordinary skill in the art. *In re Fout* 213 USPQ 532 (CCPA 1982); *In re Susi* 169 USPQ 423 (CCPA 1971); *In re Siebentritt* 152 USPQ 618 (CCPA 1967); *In re Ruff* 118 USPQ 343 (CCPA 1958). Rosset teaches that hydrogen-permeable membranes comprising platinum or platinum alloys are well known in the art. In particular, platinum may be employed to improve the permeability of the membrane to hydrogen without sacrificing purity of the gaseous product or without weakening the structural properties of the membrane (column 2, lines 31-39).

7. Claim 44 is rejected under 35 U.S.C. 103(a) as being unpatentable over Minet et al. (US 5,229,102) in view of Mikus et al. (WO 99/18392) and Topsoe (US 5,169,717), as applied to claim 1 above, and further in view of Edlund (US 5,861,137).

Minet et al. is silent as to the apparatus further comprising a methanation catalyst packed within said inside section **11a**. Edlund (FIG. 3; column 5, lines 9-40) teaches a steam reforming reactor **12** including an annulus (i.e., annular reforming region **62**) containing reforming catalyst **102** and an inside section defined by a hydrogen-selective, hydrogen-permeable membrane (i.e., membrane tube **54**) positioned on the outside of said section; the apparatus further comprising a methanation catalyst (i.e., polishing catalyst **110**) packed within said inside section to react with any trace amounts of CO present in the hydrogen **103** which permeates through said membrane **54**. It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a methanation catalyst within the inside section **11a** in the modified apparatus of Minet et al., on the basis of suitability for the intended use, because the methanation catalyst converts carbon monoxide and carbon dioxide impurities that remain in the hydrogen stream into

methane, which is considered relatively inert or innocuous to fuel cells, whereas carbon dioxide and carbon monoxide are poisonous to fuel cells, as taught by Edlund (column 5, lines 27-40).

Response to Arguments

8. Applicant's arguments filed on November 8, 2006 have been fully considered but they are not persuasive. At page 2 (first paragraph) of the response, Applicants argue,

> "Neither Minet, Mikus nor Topsoe teach a steam reforming reactor-fuel cell system with the fuel cell system in communication with the hydrogen outlet of the steam reforming reactor. As such, the prior art references do not teach or suggest all of the claim limitation of claim 1 and no *prima facie* case of obviousness has been established..."

It is noted that Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. In any event, the Examiner respectfully disagrees with Applicant and maintains that the modified apparatus of Minet structurally meets the claims.

As commented in the rejection above, Minet et al. discloses that the steam reforming reactor **10** may be used for generating hydrogen for applications requiring higher pressures, such as the production of ammonia (column 4, lines 52-57). Therefore, it would have been obvious for one of ordinary skill in the art at the time the invention was made to incorporate the steam reforming reactor **10** in a plant for the production of ammonia, as specifically suggested by Minet et al. Minet et al., however, is silent as to the apparatus comprising b) a fuel cell in communication with the outlet **12a** for hydrogen of said steam reforming reactor **10**. Hence, the prior art reference to Topsoe et al. was relied upon to teach said feature. In particular, Topsoe (FIG. 3, 4; column 6, line 32 to column 7, line 39) teaches an apparatus comprising a steam

reforming reactor (i.e., for primary reforming, or secondary reforming) located in the "front end" portion **24** of a plant for the production of ammonia. In addition, the apparatus comprises a fuel cell **29** in communication with the hydrogen outlet of the steam reforming reactor (see figures). It would have been obvious for one of ordinary skill in the art at the time the invention was made to provide a fuel cell to the modified apparatus of Minet et al., on the basis of suitability for the intended use thereof, because incorporating a fuel cell into the ammonia process improves the overall energy balance of the process by offering a possibility for using a purge gas containing hydrogen as well as an off-gas of carbon dioxide to generate electricity, as taught by Topsoe (column 1, lines 17-55).

It is noted that the feature upon which Applicant appears to rely (i.e., a direct communication between the anode of the fuel cell and the outlet for hydrogen of the steam reforming reactor) is not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

* * *

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer A. Leung whose telephone number is (571) 272-1449. The examiner can normally be reached on 9:30 am - 5:30 pm Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola can be reached on (571) 272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Jennifer A. Leung
January 16, 2007

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